1.0 Characterization of the Watershed

The Pahsimeroi River subbasin (Hydrologic Unit Code [HUC] #17060202) is located in east-central Idaho between the Lost River Mountain Range and the Lemhi Mountain Range (Figure 1). The Pahsimeroi River originates near the highest peak in Idaho, Borah Peak, within the Lost River Range. The river flows northward and joins the Salmon River near the town-site of Ellis. The Pahsimeroi River subbasin is somewhat unique in Idaho in that streams from the mountains disappear into the gravel-filled valley and feed the base flow of the Pahsimeroi River from primarily subsurface flow (Young and Harenberg, 1973).

The drainage area of the Pahsimeroi River is about 839 (Bureau of Land Management [BLM], 1999a) to 845 (Young and Harenberg, 1973) square miles. Elevations of the valley floor vary from 7,800 feet near the divide with the Little Lost River drainage to 4,600 feet at the confluence with the Salmon River. Elevations in surrounding mountains are as high as 10,971 feet in the Lemhi Mountains, 12,662 feet (Borah Peak) in the Lost River Mountains, and 9,550 feet in the Donkey Hills, which separate the drainage from the Little Lost River.

Portions of this document are excerpted from a biological assessment completed by the BLM (BLM, 1999a) under the requirements of the Endangered Species Act. The Pahsimeroi subbasin assessment and TMDL utilizes factual information from existing authorities that have linkage to the water quality conditions of the Pahsimeroi River Subbasin.

1.1 Climate

The climate of the Pahsimeroi River subbasin is typical of central Idaho mountainous areas with cold winters and hot, dry summers affected by Pacific maritime air masses. Influences of elevation, topography, and aspect cause climate conditions to be variable throughout the subbasin.

Mean annual precipitation ranges from less than 8 inches on the valley floor to more than 30 inches in the higher elevations of the Lemhi and Lost River Ranges (Young and Harenberg, 1973). Most of the precipitation in the mountains occurs as snow during the winter months. A National Weather Service station at May, Idaho, (1961-1989) on the valley floor showed mean monthly precipitation levels varying from 0.28 inches in January and February to 1.43 inches in June (Abramovich et al., 1998). Average annual precipitation was 8.23 inches. Average monthly temperatures at the same station ranged from 19.5^{o} F (-6.9^{o} C) in January to 66.3^{o} F (19^{o} C) in July. Extreme temperatures for the same time period (1961-1989) are 101^{o} F (38.3^{o} C) set on August 3, 1961 and -40^{o} F (-40^{o} C) on December 23, 1983.

1.2 Geology

The Lost River Range and Lemhi Mountain Range parallel the sediment-filled Pahsimeroi Valley. Both ranges are part of the Basin and Range fault block complex of eastern and central Idaho formed nearly 17 million years ago (Alt and Hyndman, 1989). This faulting created the mountain ranges surrounding the flatter Pahsimeroi Valley bottom. The steeper gradients present along the Lemhi range indicate high-angle faulting as compared to the flatter Lost River Range to the west. The divide between the Pahsimeroi and Little Lost River subbasins is formed by the Donkey Hills. It was originally believed that the Pahsimeroi and Little Lost River basins ran together as one, north into the Salmon River until the formation of the Donkey Hills. The Donkey Hills appear to be

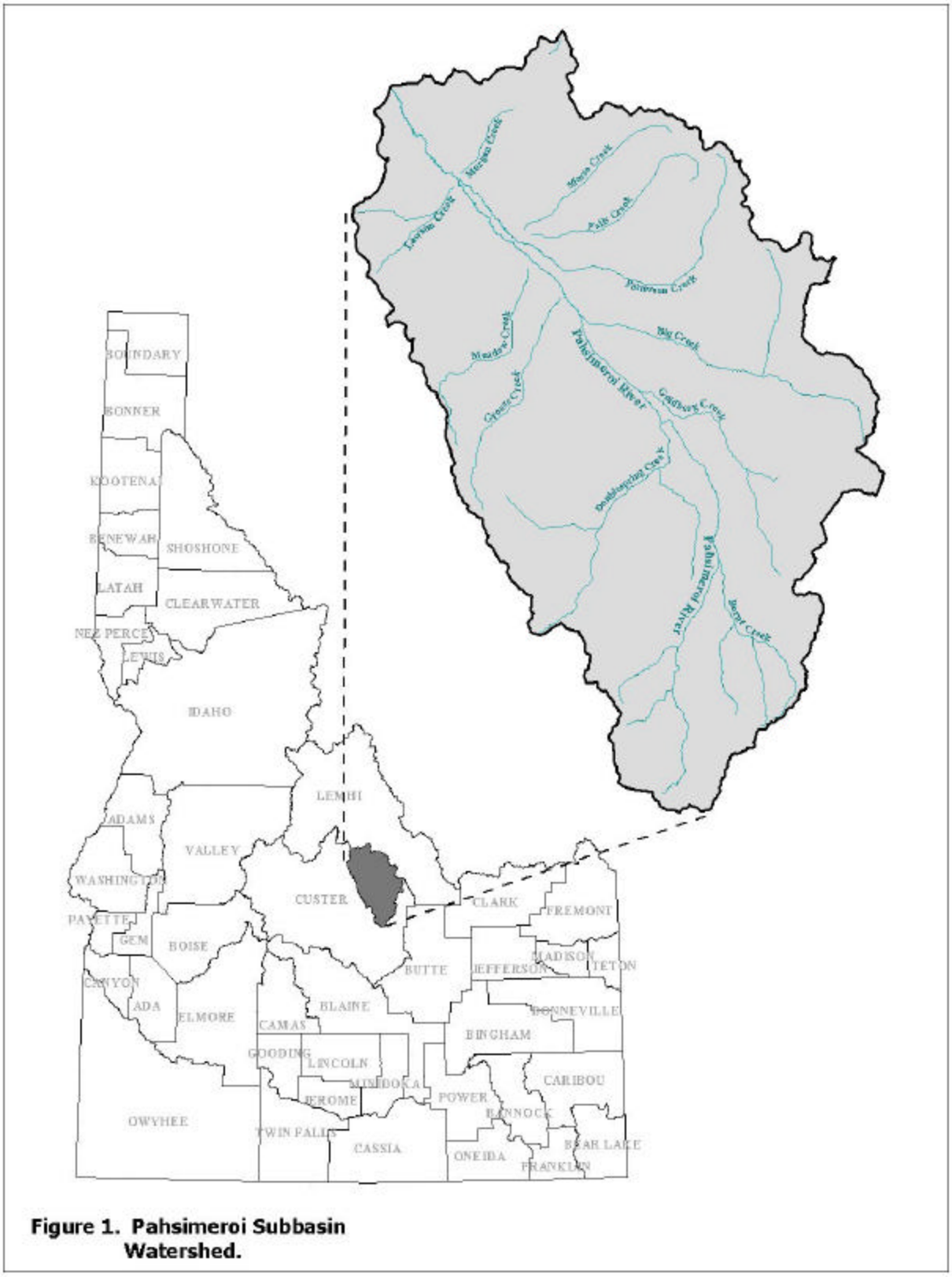

Figure 1. Pahsimeroi Subbasin Watershed.

ancient terraces and alluvial slopes uplifted to form a barrier between the two valleys (Meinzer, 1924).

The last major fault movements occurred in 1983 (the Borah Peak earthquake). Mount Borah is located on the southern edge of the subbasin in the Lost River Range (Maley, 1987). As a result of the earthquake, the Lost River Range raised one foot while the valley floor dropped four feet. Secondary effects induced by the earthquake were landslides, ground cracking along the western side of the Lost River Range, and slight flow alterations of nearby streams.

The geology of the Pahsimeroi subbasin and its mountain ranges is variable (Figure 2). Underlying much of the valley and adjacent mountain ranges are metamorphosed gneiss and schist (Alt and Hyndman, 1989). This undifferentiated complex is referred to as the Precambrian Basement Rocks, which were formed from old continental crust that elevated to the earth surface nearly 1,500 million years ago.

Sedimentary rocks formed during the Paleozoic Era, about 500 to 600 million years ago, were deposited on top of Precambrian formations and are most prevalent along the Lost River Range. Paleozoic sediments consist of predominantly limestone and dolomite with small shale and sandstone zones (Young and Harenberg, 1973).

Volcanic flows, also known as the Challis Volcanics, that occurred approximately 50 million years ago overlie portions of the Lemhi and Lost River Range (Alt and Hyndman, 1989). The Challis Volcanics are a thick series of rhyolytic volcanic flows and tuffs that cover large parts of east-central Idaho. The Challis Volcanics are comprised mostly of brown or black, fine-grained basalt or light colored ash flow tuffs.

Glacial, alluvial, and fluvial deposits cover Pahsimeroi Valley floor (Young and Harenberg, 1973). Portions of the Lemhi and Lost River Ranges got their jagged appearance from glacial erosional processes. Glacial deposits within the valley consist of heterogeneous mixtures of igneous and sedimentary rock fragments originating from the adjacent ranges. Large alluvial fans are present on the margins of the valley and continue along the Pahsimeroi River. The abundance of these deposits on the Pahsimeroi Valley floor cause the Pahsimeroi River to flow virtually underground in certain areas.

1.3 Topography

The Pahsimeroi River valley is a long, linear valley that varies in width from about one mile at its narrow mouth to 10 miles wide at its widest point. The valley is characterized by large alluvial fans spreading out from the mountain ranges and coalescing on the valley floor (Young and Harenberg, 1973). The river travels from the southeast to the northwest, thus most aspects are southwest on the north side of the valley and northeast on the south side. Mountain slopes are very steep at higher elevations, decreasing as one descends the alluvial fans to the broad U-shaped valley.

1.4 Vegetation

The natural vegetation of the Pahsimeroi River valley and lower mountain slopes and alluvial fans is characterized as open, low sagebrush or Wyoming big sagebrush (*Artemisia ssp*.) and bluebunch wheatgrass communities (*Psuedoroegneria spicata*) or alkali-tolerant chenopod shrubs such as

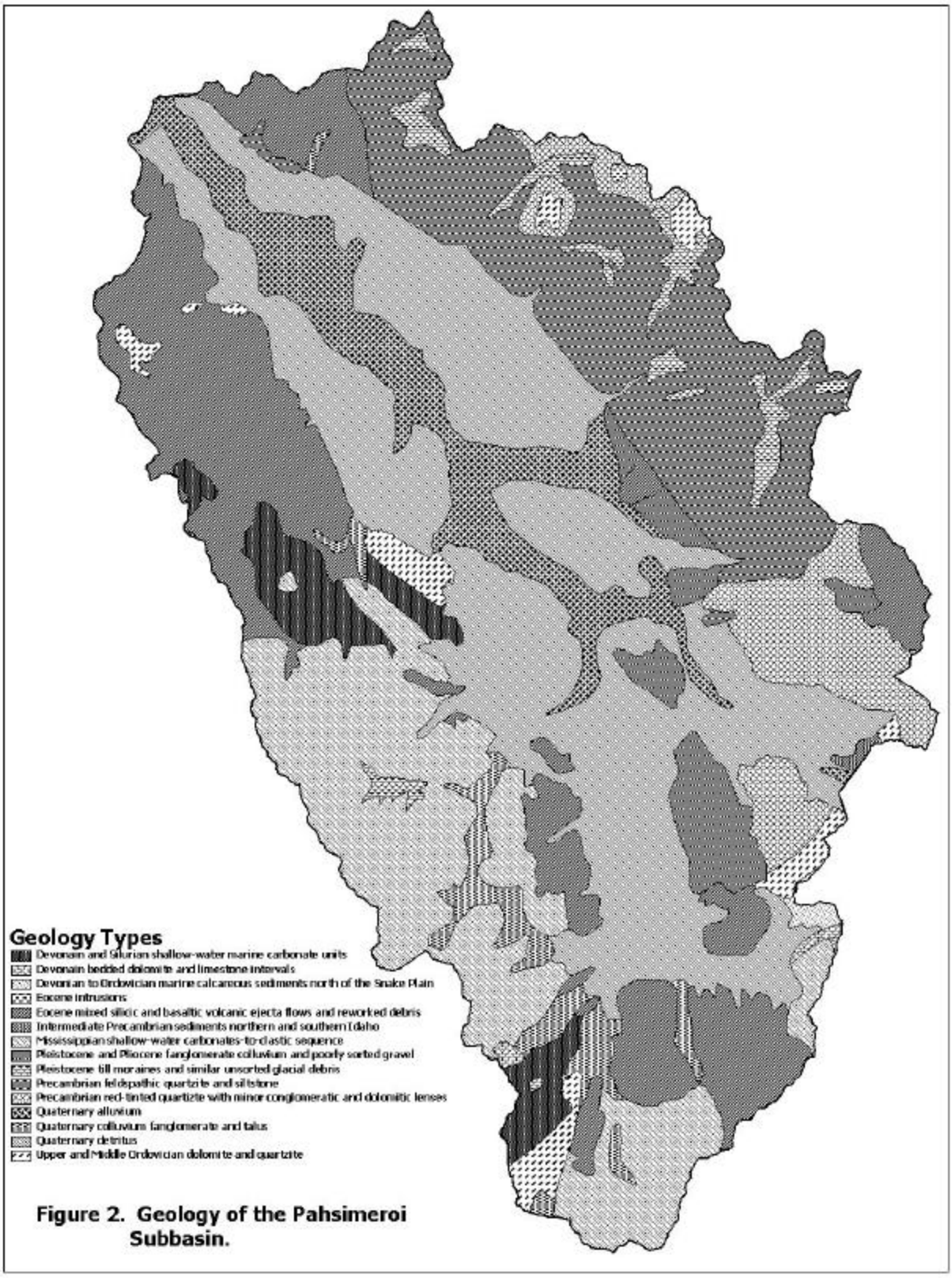

Figure 2. Geology of the Pahsimeroi Subbasin.

saltbush (*Atriplex ssp*.) and greasewood (*Sarcobatus vermiculatus*) (Chatters, 1982). Upper elevations transcend into mountain brush communities containing mountain mahogany (*Cercocarpus ledifolius*), bitterbrush (*Purshia tridentata*), snowberry (*Symphoricarpus ssp*.), some occasional junipers (*Juniperus ssp*.), and eventually mixed conifers of two types. The BLM identifies these two forest community types as:

> "Grand Fir/Douglas-fir Forest *(Abies/Pseudotsuga)* communities include tall, needle-leaf evergreen forest dominated by Grand fir *(Abies grandis)* and Douglas-fir *(Pseudotsuga menziesii),* with a mix of *Larix occidentalis, Pinus monticola* and *Populus tremuloides.*
>
> Western Spruce/Fir Forest *(Picea/Abies)* communities include dense to open forest of low to medium tall needle-leaf evergreen trees and open forests with a component of shrubs and herbaceous plants. Dominant vegetation includes subalpine fir *(Abies lasiocarpa)* and Englemann spruce *(Picea engelmannii)."* (BLM, 1999a)

Also, limber pine (*Pinus flexilis*), lodgepole pine (*Pinus contorta*), and whitebark pine (*Pinus albicaulis*) occur at high elevations and rocky, talus areas (Chatters, 1982). Riparian vegetation tends to be dominated by willows and sedges (Idaho Soil Conservation Commission [ISCC], 1995). Wet areas can include cattails and tufted hairgrass (*Deschampsia cespitosa*). Alkaline soils where the water table fluctuates contain alkali Sacaton (*Sporobolus airoides*). The valley floor and several areas in the Big Creek and Patterson Creek drainages have been converted to irrigated agriculture.

1.5 Land Ownership and Use

Most of the land within the subbasin is within public ownership (Figure 3). Both mountain ranges are in the Salmon-Challis National Forest, and lower slopes to the valley floor are BLM lands. Throughout the BLM land are sections of state land, including one large block of state-owned land in the upper Goldberg Creek drainage. Private lands are found on both sides of the Pahsimeroi River throughout the valley. There are two large pieces of private land in the Big Creek and Patterson Creek drainages near the interface of BLM and Forest Service land.

> "The total area of the watershed is 537,210 acres (839 square miles): 224,278 acres (41.7%) of BLM administered public lands (BLM lands); 47,035 acres (8.8%) of private land; 19,159 acres (3.6%) of State land; and 246,717 acres (45.9%) of Forest Service lands." (BLM, 1999a)

The principal land use of the subbasin is agriculture, from irrigated agricultural activities on the valley floor to livestock grazing throughout much of the rangeland areas (Figure 4). In terms of land area, 30,000 acres of the subbasin are in irrigated agriculture (hay, pasture or crop); 263,430 acres are rangelands; and the remaining 244,970 acres are primarily National Forest lands (timber and range) (ISCC, 1995). Irrigation water rights amount to approximately 900 cubic feet per second (cfs) (ISCC, 1995). Most irrigation is in the form of sprinkler irrigation from wells in the valley floor. Gravity flow irrigation for about 7,400 acres also exists in the Big Creek and Patterson Creek drainages and the upper end of the Goldberg Creek area. There is one area of dryland agriculture just south of Patterson. Idaho Power has water rights to 50 cfs for its fish hatchery (ISCC, 1995).

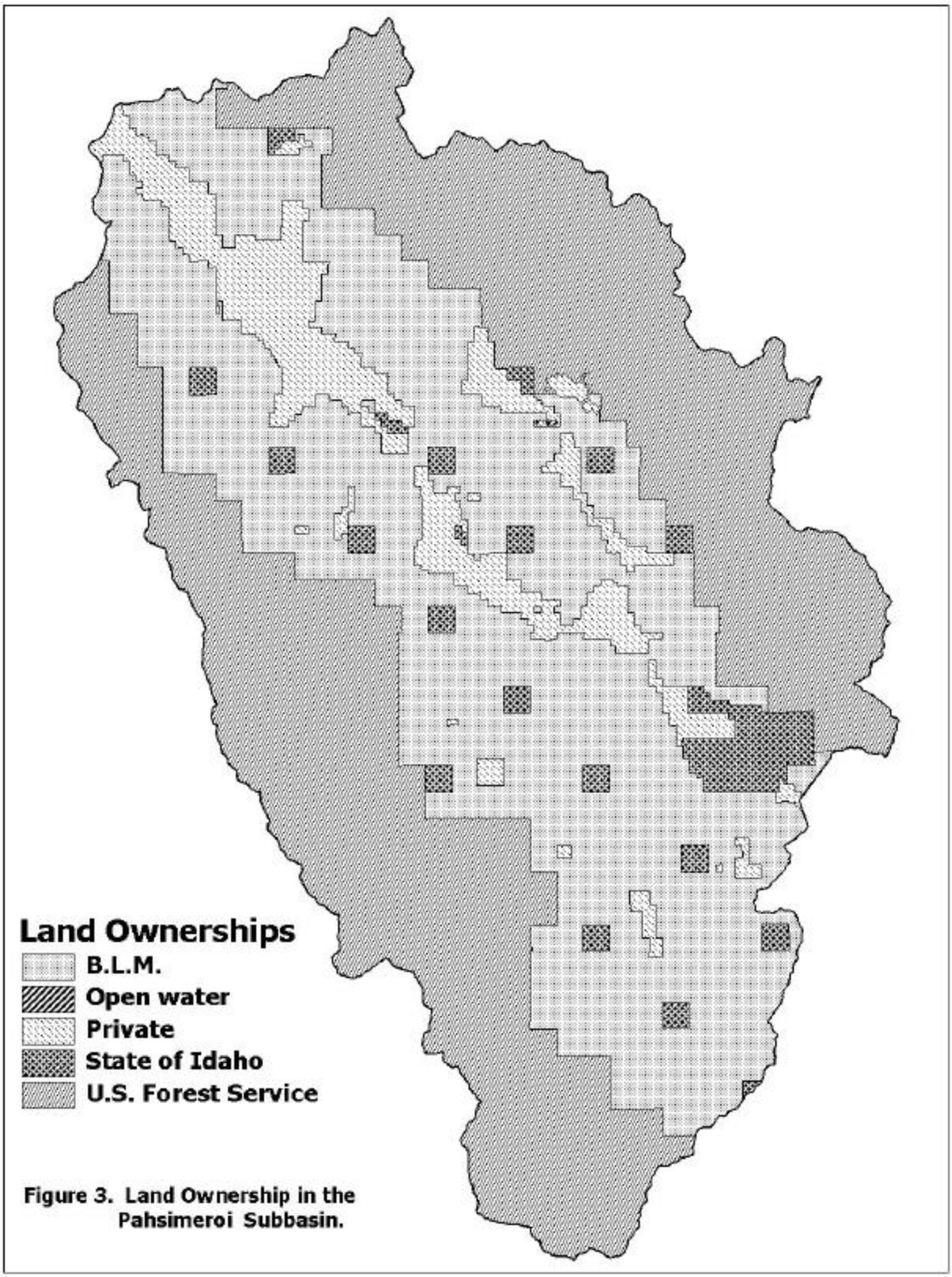

Figure 3. Land Ownership in the Pahsimeroi Subbasin.

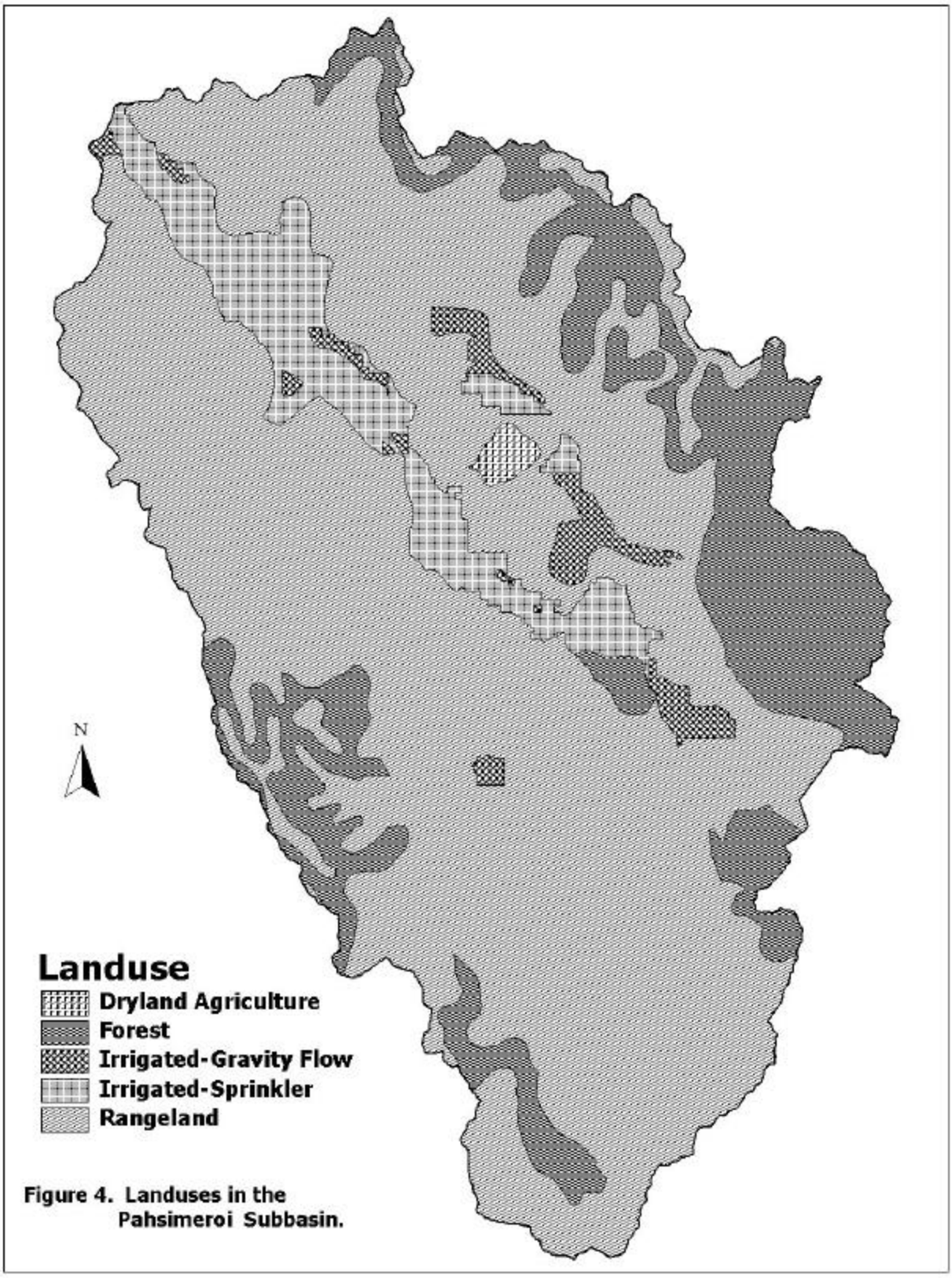

Figure 4. Landuses in the Pahsimeroi Subbasin.

Mining in the subbasin is limited and mostly historical; the tungsten mine in Patterson Creek is most notable (ISCC, 1995). Patterson Creek flows through this mine area, but is diverted or subsides below ground before reaching the Pahsimeroi River. Logging has been very limited in the subbasin due to lack of timber resources (ISCC, 1995).

The Pahsimeroi River subbasin is split between Custer and Lemhi Counties, with the Pahsimeroi River and Big Creek forming the boundary between the two counties. Custer County has a population of about 4,200 people and Lemhi County has over 8,000 people (Idaho Department of Commerce, 1999). The population base within the subbasin is very small and associated with private agricultural lands in the valley bottom. There are several place names or small towns including Patterson, May, Goldberg, and Ellis. The Pahsimeroi Valley was settled during the late 1800s and early 1900s (Meinzer, 1924). By 1920, the valley's population had swelled to 569 people and 8,277 acres of irrigated crop and pasture land (Meinzer, 1924). The population has probably decreased from these early levels. In 1990 the U.S. Bureau of Census reported 60 people living in May and four people in Patterson. Most of the roads within the valley are associated with agricultural lands. There are two main roads that travel the length of the valley on either side of the Pahsimeroi River. There are numerous primitive roads that travel perpendicular to the valley up through the BLM land to the National Forest boundaries.

1.6 Hydrology

According to the BLM's *Pahsimeroi Watershed Biological Assessment* (BLM, 1999a):

> "The watershed area contains the Pahsimeroi River, a stream approximately 50 miles long from its source on the north face of Leatherman Peak to its confluence with the Salmon River at Ellis…. Major tributaries include Little Morgan, Tater, Morse, Falls, Patterson, Big and Goldburg Creeks draining from the western slopes of the Lemhi Range, and Lawson, Sulphur, Meadow, Grouse and Double Springs Creeks draining from the eastern slopes of the Lost River Range (Figure 5). The upper Pahsimeroi drainage, from the sinks upstream, includes the East and West Forks of the Pahsimeroi River, Mahogany Creek, Burnt Creek and its tributaries Long and Short Creeks. These tributaries potentially contribute up to 1,495 cfs, collectively, to the Pahsimeroi River during average high flows (Young and Harenberg 1973) (Table 3). Extensive irrigation diversions and large natural percolation losses to the coarse alluvial materials associated with each of these tributaries precludes any significant amounts from reaching the river proper except during high surface-runoff periods. Three types of irrigation ditches exist in the watershed: those used for agricultural irrigation; those for livestock watering; and those used to transfer water from one drainage to another to enhance flows for other purposes. The main Pahsimeroi River at its mouth generally has a maximum mean monthly flow of approximately 279 cfs in November, and a minimum mean monthly flow of 133 cfs in May (Young and Harenberg 1973; Meinzer 1924.) The main Pahsimeroi River dries up in sections during late summer and winter, primarily in the 'sinks' area located between the confluence of Goldburg Creek and Summer Crossing road below Burnt Creek and occasionally at locations higher in the watershed. Whether this condition existed prior to settlement is unknown."

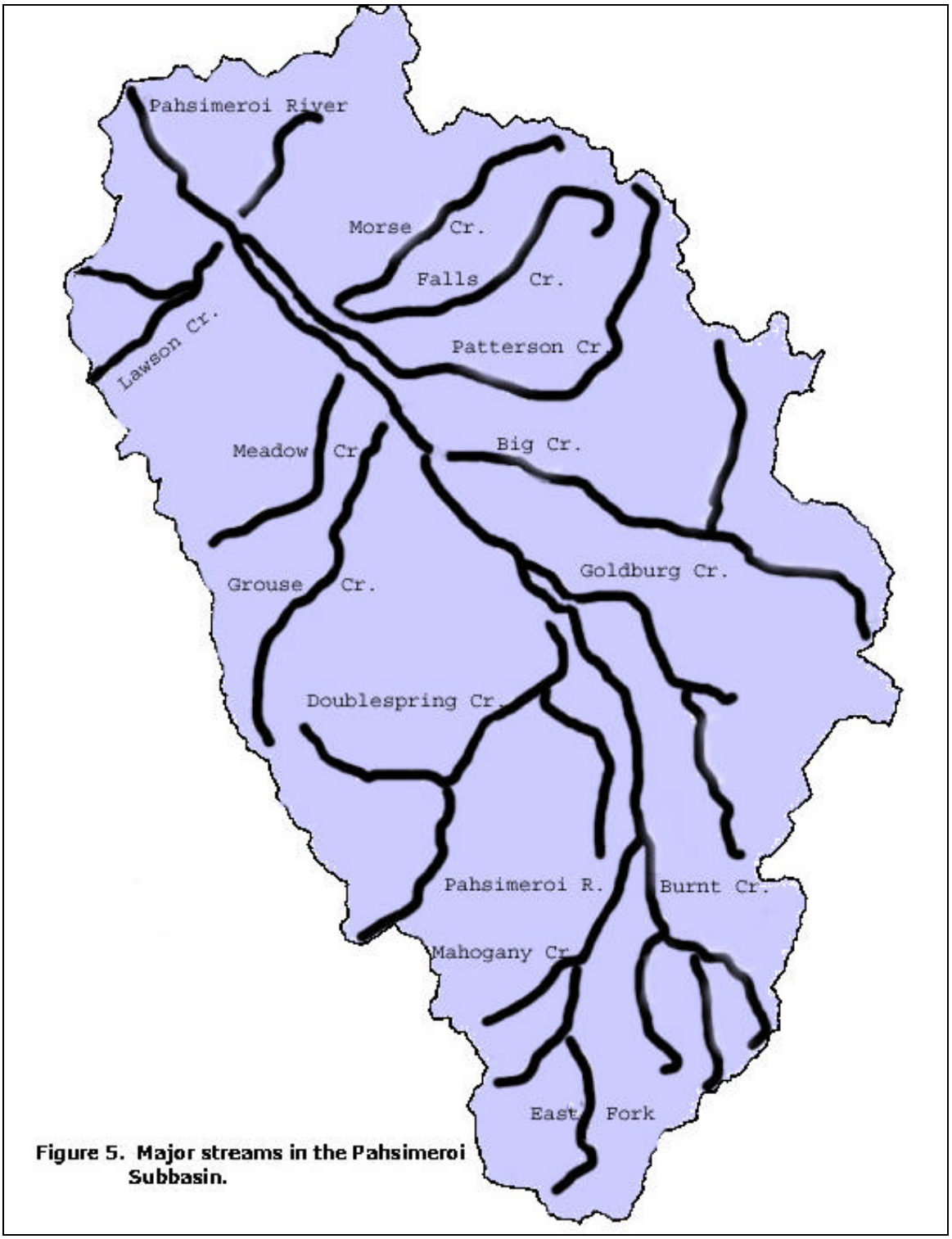

Figure 5. Major streams in the Pahsimeroi Subbasin.

Table 3 Estimated mean monthly discharge in cubic feet per second (cfs) of selected streams in the Pahsimeroi River Basin (adapted from Young and Harenberg 1973).

Stream	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Pahsimeroi River (below forks)	40	180	128	47	25	20	-	-
Mahogany Creek	18	78	44	17	9	7	7	6
Burnt Creek	38	116	47	19	11	8	8	7
Big Creek	86	380	123	56	34	26	24	26
Grouse Creek	2.4	5.5	0.2	0.4	0.9	1.2	0.0	0.0
Meadow Creek	4.1	2.5	1.2	0.5	0.5	0.7	0.4	0.4
Sulphur Creek	2.9	2.0	0.9	0.5	0.8	1.2	0.8	0.8
Trail Creek	3.0	2.0	0.9	0.5	0.8	1.0	0.9	0.8
Patterson Creek	88	257	102	43	26	16	17	14
Falls Creek	50	136	44	19	12	8	9	8
Morse Creek	60	123	30	14	9	7	7	7
Tater Creek	17	39	9	4	3	2	2	2
Lawson Creek	5	3	2	1	1	2	1	1
Little Morgan Creek	78	171	26	14	11	6	7	8
Total	**492**	**1495**	**558**	**236**	**144**	**106**	**84**	**81**

Meinzer (1924) indicated that in the early 1920s the Pahsimeroi River was perennial from Golberg Creek to its mouth. By exclusion, this suggests that above Goldberg Creek the Pahsimeroi River was intermittent, as the BLM has suggested. According to Meinzer (1924) the Pahsimeroi River lost 20 "second-feet" to subsurface flow between the mouth of the canyon near the forest boundary and the first diversion (near Burnt Creek). In the early 1920s the Pahsimeroi River between Burnt Creek and Goldberg Creek (7-8 miles) only had surface flow during very high flow time periods (Meinzer, 1924).

Other streams were similarly flow compromised in the 1920s. Meinzer (1924) described Big Creek below the canyon mouth as loosing more water to subsurface flow than to irrigation diversions. At that time, Big Creek flow reached the Pahsimeroi River for about 20 days out of the year. Patterson Creek flow reached the Pahsimeroi River only during the peak in high flow season. Falls Creek was apparently similar to Patterson Creek in the 1920s except that it was usually completely diverted for agriculture. Double Springs Creek never reached the Pahsimeroi River during Meinzer's time.

The water table in the Pahsimeroi Valley was at or near the surface for 25 miles from the mouth of the river to Goldberg Creek (Meinzer, 1924). The water table had a large annual fluctuation with

well depths shallowest from February to May and deepest (10 – 38 feet) between June and September. Meinzer (1924) also reported water temperatures for springs located throughout the subbasin. Spring water temperatures varied from 44.5° F (6.9° C) to 57° F (13.9° C). Most were below 50° F (10° C), although a few were greater than 50° F.

1.7 Fish

The Pahsimeroi Watershed Biological Assessment (BLM, 1999a) notes:

> "There are 10 known species of fish distributed throughout the Pahsimeroi River watershed. These include Chinook salmon *(Oncorhynchus tshawytscha),* steelhead rainbow trout (*O. mykiss*), rainbow trout *(O. mykiss),* westslope cutthroat trout (*O. clarki*), bull trout *(Salvelinus confluentus),* brook trout (*S. fontinalis*), mountain whitefish *(Prosopium williamsoni),* redside shiner *(Richardsonius balteatus),* sculpin *(Cottus spp.),* dace *(Rhinichthys spp.),* longnose sucker *(Catostomus catostomus),* and northern squawfish *(Ptychocheilus oregonensis).* Of these, all but the brook trout are indigenous to the system. Brook trout hybridization with bull trout has been identified as one of the factors contributing to the decline of bull trout. Table VII [Table 4] shows known distribution of fish species."

> "Distribution of indigenous fish species into what are now disjunct drainages probably occurred prior to colonization and agricultural dewatering. It is unlikely that conditions conducive to fish dispersal were enhanced by agricultural practices. Natural dewatering of stream reaches are known to occur in this watershed, but the extent is unknown and masked by historic and long term agricultural dewatering. A historic hydrologic connection between at least those streams containing bull trout, westslope cutthroat trout and rainbow trout can be inferred from the current distribution of salmonids. Since access to these hydrologic units existed for these fish species, accessibility to these streams by chinook salmon and steelhead rainbow trout is probable. This includes that portion of the Pahsimeroi River above the 'sinks.'"

According to the Model Watershed Plan (ISCC, 1995), spring/summer Chinook and steelhead utilize spring-fed areas in the upper watersheds to spawn. As long as there is adequate flow in the spring to successfully migrate, these fish can utilize these isolated habitats later in the year.

> "There are approximately 237 miles of sensitive fish aquatic habitat distributed between BLM, FS [U.S. Forest Service] and State/private within the watershed, which includes a large but undetermined proportion dewatered by agricultural diversions. Typically, the FS administers the upper reaches of a drainage, BLM manages the middle reaches and the lower reaches are private, State or other; although variations of these ownership patterns exist. The FS sections of streams are usually located in the mountainous regions of the watershed and well above any dewatering point. These reaches are the primary perennial sections of most tributary streams, including the upper Pahsimeroi River. As a result, they are also where most fish populations remain on FS or BLM lands, although there are exceptions. Table lll [Table 5] shows stream miles and primary ownership of the primary perennial streams in the Pahsimeroi River watershed." (BLM, 1999a)

Table 4 Fish species' presence within the Pahsimeroi River watershed (Idaho Department of Fish and Game 1992c; BLM files).

Stream	Date	Fish Species Present[1]
Pahsimeroi River, mouth to Big Creek[2]	8/21/91	CH, SH, BT, BRT, MWF, RS ,SC ,DA, SK, SQ
Pahsimeroi River, above Big Creek[3]	9/1/94	BT, SC
Little Morgan Creek[2]	7/30/91 8/30/94	BT, WSCT BT, WSCT
Tater Creek[2]	7/24/91 6/21/94	BT BT
Morse Creek[2]	7/30/91 8/30/94 10/3/94	BT, WSCT BT, WSCT BT, WSCT
Falls Creek[2]	7/30/91 8/31/94	BT, WSCT (IDFG IRIS[4] Records) BT
Patterson Creek[2]	7/25/91 8/31/94	BT, WSCT (IDFG IRIS[4] Records) BT
Big Creek[2]	8/5/91 7/26/94	BT, SH BT, WSCT
Ditch Creek[2]	6/20/94	BT
Goldburg Creek[2]	7/10/91	BT, BRT
Big Gulch Creek[2]	7/10/91 6/10/94	BT BT
Donkey Creek[2]	6/7/94	WSCT, RB
Burnt Creek[3]	6/1/94	BT, RB
Short Creek[3]	6/2/94	RB
Mahogany Creek	6/2/94	BT
Sulphur Creek[2]	7/9/91 6/28/94	RB No fish observed
Lawson Creek[2]	7/8/91 6/28/94	RB RB

CH=chinook salmon, SH=steelhead/rainbow trout, RB=rainbow trout, BT=bull trout, WSCT=westslope cuttroat trout, BRT=brook trout, MWF=mountain whitefish, RS=redside shiner, SC=sculpin, DA=dace, SK=sucker, SQ=squawfish;
[2] Portions of stream dewatered through agricultural activities
[3] Natural dewatering occurs during annual hydrologic cycle
[4] Idaho Department of Fish and Game Idaho River Information System

Table 5 Distribution of sensitive salmonid species within the Pahsimeroi River watershed, by known occurrence, with probable historic distribution for Chinook salmon.

Drainage	BLM[1] Miles	FS[2] Miles	State Private Miles	Total Stream Miles	Miles Occupied Chinook Habitat	Miles Historical Chinook Habitat	Miles Occupied Steelhead-Rainbow Habitat	Miles Bull Trout Habitat	Miles Westslope Cutthroat Trout Habitat
Pahsimeroi River to Big Creek	1.7	0.0	18.0	19.7	19.7	19.7	19.7	19.7	19.7
Little Morgan Creek	5.7	8.6	0.0	14.3	0.0	14.3	0.0	14.3	14.3
Tater Creek	3.4	2.9	0.0	6.3	0.0	0.0	0.0	6.3	0.0
Morse Creek	4.7	7.1	0.0	11.8	0.0	11.8	0.0	11.8	11.8
Falls Creek	6.0	8.0	0.0	14.0	0.0	14.0	0.0	14.0	14.0
Patterson Creek	7.4	12.3	10.0	29.7	5.0	29.7	5.0	29.7	29.7
Big Creek	7.4	17.7	4.0	29.1	0.0	29.1	29.1	29.1	29.1
Ditch Creek	2.1	2.9	0.6	5.6	0.0	0.0	0.0	5.6	0.0
Goldburg Creek	1.0	0.0	14.3	15.3	0.0	15.3	0.0	15.3	15.6
Big Gulch Creek	0.0	4.6	5.7	10.3	0.0	10.3	0.0	10.3	10.3
Donkey Creek	4.0	0.0	2.4	6.4	0.0	0.0	5.6	0.0	0.0
Pahsimeroi River from Big Creek	17.1	18.9	9.7	45.7	0.0	45.7	17.8	17.8	17.8
Burnt Creek	9.4	4.6	2.9	16.9	0.0	16.9	16.9	16.9	0.0
Short Creek	5.7	0.0	0.0	5.7	0.0	0.0	5.7	0.0	0.0
Mahogany Creek	2.3	3.6	0.0	5.9	0.0	5.9	0.0	5.9	0.0
Total	**77.9**	**91.2**	**67.6**	**236.7**	**24.7**	**212.7**	**99.8**	**196.7**	**162.3**

[1] U.S. Bureau of Land Management
[2] U.S. Forest Service

According to the Model Watershed Plan (ISCC, 1995), habitat for salmon and steelhead within the subbasin is restricted to two areas: the Pahsimeroi River from its mouth to Hooper Lane, and Patterson-Big Springs Creek. The plan indicates that the quality of this fish habitat could be improved and water temperatures could be reduced by implementing voluntary ranch plans, which include water development, fencing of riparian areas, revegetation and planned grazing systems. These projects are the intent and purpose of the Model Watershed Project and are currently being implemented in the subbasin.